

What is claimed is:

1. A method for dry-etching a Si substrate or a Si layer in a processing chamber, comprising the step of:

5 supplying an etching gas into the processing chamber, wherein the etching gas is a mixture gas including Cl_2 , O_2 and NF_3 and a residence time τ of the etching gas is equal to or greater than about 180 msec, the residence time τ being defined as:

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$$\tau = pV/Q$$

where p represents an inner pressure of the processing chamber; V , an effective volume of etching space formed on the Si substrate or the Si layer; and Q , a flow rate of the etching gas.

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2. The method of claim 1, wherein a sum of flow rates of Cl_2 and O_2 is equal to or less than about 80% of a flow rate of the etching gas.

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3. The method of claim 1, wherein a ratio of a flow rate of O_2 to a sum of flow rates of Cl_2 and O_2 ranges from about 0.1 to about 0.3.

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4. The method of claim 1, wherein the flow rate of the etching gas is equal to or less than about 100 sccm.

5. The method of claim 1, wherein the inner pressure of the processing chamber ranges from about 20 mtorr to about 200 mtorr.
- 5 6. The method of claim 1, wherein the processing chamber is provided with two electrodes for generating a plasma of the etching gas therebetween and a distance between the electrodes ranges from about 30 mm to about 300 mm.
- 10 7. An apparatus for etching a Si substrate or a Si layer, comprising:
- a processing chamber which is provided with a gas inlet and a gas outlet, and removably accommodates therein the Si substrate or an object having the Si layer;
 - 15 an etching gas supply unit which mixes Cl_2 , O_2 and NF_3 to provide an etching gas and supplies the etching gas to the processing chamber through the gas inlet;
 - a plasma generator for generating a plasma of the etching gas;
 - 20 a discharge unit which evacuates an interior of the processing chamber through the gas outlet to maintain an inner pressure of the processing chamber at a level,
- wherein etching of the Si substrate or the Si layer is carried out while maintaining a residence time τ at a level
- 25 equal to or greater than about 180 msec, the residence time τ being defined as:

$$\tau = pV/Q$$

where p represents an inner pressure of the processing chamber; V, an effective volume of etching space formed on the Si substrate or the Si layer; and Q, a flow rate of the etching gas.

8. The apparatus of claim 7, wherein the etching gas supply unit supplies the etching gas into the processing chamber such that a flow rate of the etching gas is equal to or less than about 100 sccm.

9. The apparatus of claim 7, wherein the discharge unit maintains the inner pressure of the processing chamber at a level ranging from about 20 mtorr to about 200 mtorr.

10. The apparatus of claim 7, further comprising an upper electrode and a lower electrode in the processing chamber wherein a distance between the upper electrode and the lower electrode ranges from about 30 mm to about 300 mm.